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CONTENTS

Quarterly meeting of Federal Fire Council.
Meeting of American Physical Society.
Twenty-Fourth National Conference on Weights and Measures.
Effect of small variations in pitch upon the inductance of a standard solenoid.
Height of Kennelly-Heaviside layer.
Aneroid altimeters for aircraft.
Damping liquids for aircraft instruments.
Altitude laboratory tests of aircraft engines.
Oil filter for automobiles.
Thermal properties of alcohol and benzene.
Controlling dimensional changes in electrotypes.
Standardization of binders board.
Deinking tests of stamped envelopes.
Corrosion-resistant pipe materials.
Freezing and thawing tests of sand-lime brick.
English china clay.
Specific gravity and porosity of kaolins after firing.
Fusion properties of typical commercial ground coat enamels.
New and revised publications issued during April, 1931.
Letter circulars prepared during April, 1931.
Recent articles appearing in outside publications.

QUARTERLY MEETING OF FEDERAL FIRE COUNCIL

The regular quarterly meeting of the Federal Fire Council was held at the Department of Commerce, April 10. Dr. George K. Burgess, chairman, presided. Twenty-two representatives from departments and establishments were in attendance. Doctor Burgess called attention to the fact that this was near the first anniversary of the organization of the group on April 3, 1930. He reviewed briefly some of the results of the year's activities. These included preliminary surveys of the institutions under the Board of Public Welfare of the District of Columbia which resulted in allowance for substantial items for fire protection in the appropriations available for the coming fiscal year. Following a request from the Committee on Rules of the Senate an inspection for fire hazard of the Senate Wing of the Capitol Building and the Senate Office Building was undertaken, and as recommended in a preliminary report on immediately needed protection measures, $100,000 was made available at the last session of Congress. Other projects completed include a report on the National Training School for Boys located on Bladensburg Road in the District of Columbia. He indicated that the benefits from these surveys are measured only in part by the appropriations made available, and that the improvements in housekeeping and greater attention paid to matters concerned with fire prevention and protection are possibly of equal or greater value.

A. G. Thomas, chairman of the Fire Hazards Committee reported on surveys in progress in the Smithsonian Institution and the Capitol group of buildings. During the period since the last meeting a fire protection survey of the Atlanta Penitentiary had been made by the field engineering department of the National Fire Protection Association which was reported at this meeting. This was a comprehensive inquiry into the structural, occupancy, and equipment conditions having a bearing on the fire hazard, and the results were embodied in a 100-page report.

W. W. Dean, chairman of the Apparatus and Appliance Committee, reported on work of the groups of his committee on various installations involving automatic sprinklers, automatic fire detecting equipment, fire doors, and other structural changes proposed in connection with the different surveys.

Dr. H. C. Dickinson reported on the preliminary work being done by the committee on inspection and interdepartmental cooperation which has consisted in obtaining data on value of Government property subject to fire loss and the measures taken for its protection.

H. W. Gardner, of the U. S. Veterans' Administration, outlined the fire

prevention and protection activities of this establishment. A number of instruction sheets, brief manuals, and report forms are provided the various stations, and check-ups on fire prevention and protection conditions are made at least once a year by an outside agency or an officer not attached to the station. The Veterans' Bureau has at present 54 field activities located throughout the country. While the newer stations have fire-resistive buildings of the most approved types, there are many buildings taken over that are at best only of semi-fire-resistive construction, necessitating the strictest care in connection with fire prevention. The loss from fire in Veterans' Bureau hospitals has been almost negligible during the past 10 years.

Capt. R. C. Montgomery, chief of the protection division of the Office of Public Buildings and Public Parks of the National Capital, described the fire prevention and protection activities in connection with the public buildings under the supervision of this office. This includes a wide range of buildings in Washington, ranging from temporary frame structures to monumental buildings, such as the Lincoln Memorial and Washington Monument. Buildings acquired for demolition on sites of new buildings are also under the care of this office, about 50 buildings being at present in this class. The buildings causing this office the most concern from the standpoint of fire hazard are the large temporary buildings constructed in 1917 and 1918 to house war activities. While a few, such as the Navy and Munitions Buildings, are of fire-resistive construction, most of them are wood-frame buildings. These buildings have at times housed as many as 30,000 employees. No fire loss of any consequence had occurred in connection with the use of these buildings until last year, when Temporary Building No. 4, occupied by the Federal Trade Commission and bureaus of the Department of Labor, was burned with loss estimated at $164,000. For the preceding 7-year period some 400 fires have occurrred in the buildings under the control of this office, most of them extinguished before any damage of consequence had occurred. The total loss from these fires is given as about $1,600, or about $4 per fire. In only seven cases was the District fire department called, and in only three of these was it required to go into action.

This record was established only as the consequence of thoroughgoing and sustained fire-prevention work, aided by drills of employees in the proper use of fire-extinguishing equipment, and maintenance of the latter in good condition. As an example, each of the 2,650 hand fire extinguishers located in these buildings is recharged every year. Smoking is prohibited in the temporary buildings, and the effect of this is shown in the less frequent occurrence of fires in these buildings than in the fire-resistive buildings where smoking is allowed and where generally the fire-prevention measures applied are less stringent. The office anticipates, with satisfaction, the demolition of the last of the temporary war buildings and the substitution for them of types of buildings such as the new Internal Revenue Building and the Commerce Building, that have incorporated in them, from standpoint of both structure and equipment, some of the features that are most effective in preventing the origin and spread of fire.

MEETING OF AMERICAN PHYSICAL SOCIETY

The one hundred and seventieth regular meeting of the American Physical Society took place in Washington on April 30 and May 1 and 2, 1931. The meetings on the first two days were held at the National Bureau of Standards and the one on May 2 at the National Academy of Sciences. The program included 159 papers, of which 11, numbered as follows, were presented by members of the bureau's staff:

No. 12, Effect of heating on Residual Magnetism, by R. L. Sanford. The changes in the structure of a 0.63 per cent carbon steel with changes in temperature and the effect of these upon magnetic properties are described.

No. 21, Columns with Variable End Restraints, by L. B. Tuckerman and W. R. Osgood. Cooperative work with the Bureau of Aeronautics, United States Navy, on strength of columns with variable elastic end restraints is discussed. Analysis led to the conclusion that satisfactory corrections could be made for rigid end mounting, which greatly simplified the test apparatus. A formula for expressing the test results is developed.

No. 22, Methods for Measuring the Coefficient of Restitution, by L. J. Briggs. A comparison is made of four methods for determining the coefficient of restitution of elastic spheres,

such as golf balls, when subjected to large deformations.

No. 29, Continuous Spectrum from Tungsten Bombarded by 800-Volt Electrons, by L. S. Taylor. Describes preliminary measurements of intensity distribution of radiation in the ultraviolet from tungsten at voltages from 500 to 1,200. At 800 volts the intensity increases regularly with decreasing wave length, being about three times greater at 2,800 A than at 3,700 A. Between 500 and 1,200 volts, the intensity distribution remains much the same and the intensity increases twofold.

No. 30, Radiation from Metals Bombarded by Low-Speed Electrons, by F. L. Mohler and C. Boeckner. This paper describes a continuation of work presented in paper No. 28 of the New York meeting. Measurements have been made with seven metals—beryllium, aluminum, copper, silver, tungsten, platinum, and thallium—in caesium discharges.

No. 51, Some Properties of Foreign and Domestic Micas, by A. B. Lewis, E. L. Hall, and F. R. Caldwell. Gives values for dielectric constant and power factor at radio-frequencies and dielectric strength at 60 cycles for representative samples of mica from principal sources of the world's supply.

No. 56, A Method for Precise Speed Control Developed in Connection with an Absolute Measurement of Resistance, by Frank Wenner and Chester Peterson. A method is described for controlling the speed of a direct-current motor by means of a piezo-oscillator so that for periods of about 10 seconds the average speed will be constant and known to within 1 part in 200,000. The arrangement has been used with success in one method employed by the bureau in its absolute measurement of resistance.

No. 59, A New Theorem Concerning Temperature-Compensated Millivoltmeters Used with Shunts for the Measurement of Current, by H. B. Brooks. Describes two kinds of compensated millivoltmeters and a simple theorem which has been found to apply to either type and which removes the limitation against low-range shunts.

No. 100, The Arc Spectrum of Rhenium, by W. F. Meggers. Photographs of the arc spectrum of rhenium from 2,100 A in the ultra-violet to 8,800 A in the infra-red show over 3,000 lines in this interval, of which 25 per cent show hyperfine structure of 2 to 6 or more components. About 500 lines, including nearly all the stronger ones, have been classified as combinations of terms belonging to quartet, sextet, and octet systems. The ionization potential is approximately 8 volts.

No. 103, Hyperfine Structures in the First Spectra of Krypton and Xenon, by C. J. Humphreys. Hyperfine structures of six lines in each of the arc spectra of krypton and xenon have been measured, using a Hilger Fabry-Perot interferometer. No definite numerical regularities in the spacing of components, such as have been reported for neon, have been observed. The existence of a reported satellite of the krypton line 5,570.2890 A has been confirmed.

No. 155, Effects of Ground Faults and Ground Connections of the Wheatstone Bridge, by Frank Wenner. It is shown that the correction to the usual bridge equation necessary to take account of the effect of ground faults in each of the source and each of the detector leads can in most cases be determined from two additional balances of the bridge. Effects of other types of ground faults and the effectiveness of various adjustments and ground connections in reducing the magnitude of the error resulting from ground faults, in case a correction is not applied, are considered.

TWENTY-FOURTH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

The Twenty-fourth National Conference on Weights and Measures will be held at the National Bureau of Standards, June 2 to 5, inclusive. Weights and measures representatives will be present from a majority of the States, and representatives of manufacturers of weighing and measuring apparatus and of numerous railroads and industries will also be present. A new feature planned for the conference this year is an exhibit of recent developments in connection with weighing scales. Scale manufacturers have been invited to place on exhibition devices which have been developed or put into use during the past 12 months. There is also expected to be an exhibit of person-weighing scales, not confined to recent developments, in connection with the consideration of a tentative code of specifications and tolerances for these scales.

A one-half-day session will be devoted to the discussion of bottles used for dispensing lubricating oils at filling stations. Such bottles are now in extensive use, but some are not in compliance with the code of specifications

for lubricating-oil bottles which has been adopted by the conference. In the case of some of these bottles, it is the contention that they are used merely as containers, the bottle being sealed and comprising a "package," the actual measuring being done by the machine which fills the bottles. There is some sentiment to the effect that all bottles should conform to the requirements adopted by the conference for bottles used as measures; it is expected that the conference will reach a definite decision upon this point.

Certain matters having to do with the maintenance of commercial weighing and measuring devices have formerly been included in the conference codes of specifications. It is now to be proposed that these be separated from the technical requirements which may properly be classed as "specifications" and be grouped under a code of "regulations" which will be recommended for adoption by the States.

Representatives of the United States Department of Agriculture will discuss the marking of packages of food under the net weight amendment to the food and drugs act and a proposed consolidation of Federal standard container legislation. A representative of the Weights and Measures Inspection Service of Canada will discuss the system of weights and measures administration in force in that Dominion. New equipments for testing large-capacity scales, recently put into service by State and local departments of weights and measures, will be described and illustrated. A representative of the Post Office Department will discuss the supervision of post-office scales. Several papers will be presented by members of the staff of the National Bureau of Standards.

Numerous other papers relating to some phase of weights and measures control will likewise be presented to the conference. Advance indications are to the effect that the conference sessions will be well attended.

EFFECT OF SMALL VARIATIONS IN PITCH UPON THE INDUCTANCE OF A STANDARD SOLENOID

In the May number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH a method is described by which the variations in pitch of a single-layer solenoid may be compared with those of the precision lathe screw used to wind it. Assuming that the pitch of the latter is constant but not known with precision, it is shown how the precision measurements of the length of the windings may be combined with the former measurements to obtain the variation in pitch of the windings relative to an ideal helix whose beginning and end points coincide with the actual one. A mathematical formula for computing the correction δL to the inductance due to this variation in pitch is then developed. This formula requires the graphical integration of a certain function times the deformation, and practical methods of evaluating it are described. Application is made to observations on two standard solenoids and shows that the correction δL to the inductance L may amount to 4 or 5 parts in 100,000, even on the most carefully constructed solenoids. In absolute measurements the correction is therefore by no means to be neglected, although it seems hitherto not to have been taken into account in determinations of the ohm.

HEIGHT OF KENNELLY-HEAVISIDE LAYER

The bureau is conducting a series of studies on the height of the Kennelly-Heaviside layer. The height of this layer above the earth's surface varies from 40 to 400 miles, and is the principal factor determining the distance of transmission of radio waves on different high frequencies. The study of this height is the most powerful means available of studying the vagaries of radio transmission. Considerable work has been done on the measurement of layer heights by the echo (or reflection or group retardation) method. With this method a very brief and sharp radio-frequency pulse (of a few ten-thousandths second duration) is transmitted thirty times per second from a transmitter to a receiver about 10 miles away. If the waves travel only along the ground a single pulse is obtained at the receiving station each thirtieth of a second. If, however, a part of the waves travel upward and the Kennelly-Heaviside layer reflects or refracts them back to the receiver, two or more pulses are received instead of one. The sky-wave pulses are retarded behind the ground-wave pulse because they have traveled a longer path. The amount of this retardation is usually from a few ten-thousandths of a second to a few thousandths of a second. At the receiving station the pulses are photographed on the moving film of an oscillograph and the time retardation of the delayed pulses thus measured.

From the time retardation and the known velocity of propagation in free space the effective height of the reflecting or refracting layer is determined.

Beginning June 1, the bureau will issue a weekly bulletin giving KHL heights. This will be broadcast by radiotelegraphy from the Arlington naval radio station, as a part of the Ursigram bulletins of cosmic data compiled by Science Service and distributed by that organization in mimeographed form to interested scientists.

Previously apparatus for this work has not been highly developed. For satisfactory work the transmitter should send out a strong pulse lasting a ten-thousandth of a second, and the receiving equipment, including the oscillograph, should be capable of receiving lograph, should be capable of receiving this without distortion or widening of the pulse. The bureau has been developing such apparatus. This includes a transmitter with suitable pulse-making equipment, special receiving sets, and amplifiers. A continuous automatic recorder of Kennelly-Heaviside layer heights has also been devised, and will permit the issuing of daily bulletins of the height if found desirable. It is expected that papers describing the apparatus will be published during the present year. When such papers are published announcements will be made in these columns.

ANEROID ALTIMETERS FOR AIRCRAFT

Although other instruments and methods are being used or are under development, both for flying level and for indicating the altitude when making blind landings, the aneroid altimeter is still of value. In particular it is used in flying level during test flights and in commercial flying when the visibility is poor.

The design of altimeters has been modified to meet the above purposes. There are now commercially available, sensitive instruments which indicate differences in altitude as small as from 2 to 5 feet for a range from 0 to 20,000 feet. Moreover, attention is being given to the best methods for making the adjustments which are required in flight.

The best performance which can be secured from these instruments at the present time has been determined at the bureau by laboratory tests on 17 instruments. The factors defining the performance are, in brief: Scale errors, temperature errors, elastic errors (drift, hysteresis, etc.), effect of vibration, and position error. It is shown that the instrumental errors while flying level in a flight of 5 to 10 hours duration at 10,000 feet will not often exceed 200 feet when using the highest quality of instrument, and this reduces to about 50 feet when corrections are applied. There are further errors in the indicated altitude due to the inherent errors of this method of measuring altitude. These errors may be as large as 10 per cent of the altitude if no corrections are applied, which reduce to about 1 per cent when corrections are made.

In order to land in poor visibility the error in indicated altitude must be as small as possible. If the aneroid altimeter is to be used for blind landings, the error should be determined from time to time by a simple flight test. When the instrument reading is corrected for this error the residual error should not exceed about 30 feet.

DAMPING LIQUIDS FOR AIRCRAFT INSTRUMENTS

Damping is required for many aircraft instruments in order to obtain steady readings. In several such instruments liquids are used as the damping agents. The resistance offered to the movement of a body in a liquid is dependent on the kinematic viscosity of the liquid. Conditions under which aircraft operate require proper instrument performance over a wide range of temperature. Hence, for a liquid to be useful for damping it should have the proper kinematic viscosity and also only a small change of kinematic viscosity with temperature.

Factors, other than kinematic viscosity and its change with temperature, influencing the choice of a damping liquid are: (*a*) Corrosion, (*b*) vapor pressure, (*c*) chemical stability, (*d*) oxidation, and (*e*) solubility. A paper which will soon be published by the National Advisory Committee for Aeronautics reports principally the results of an investigation at the National Bureau of Standards of the kinematic viscosity of selected liquids and solutions in the temperature range −50 to +30° C. Data on the other factors were only incidently obtained, except that the effectiveness of β-naphthol, hydroquinone, and diphenylamine to inhibit the change, due to oxidation, in the viscosity of poppyseed oil and of

linseed oil was investigated. Only hydroquinone was found to be effective.

The effect of temperature on the kinematic viscosity was determined for various animal, vegetable, and mineral oils, and for their solutions in mineral spirits, *m*-xylene, and toluene, and for glycerin and ethylene glycol and their solutions in various alcohols.

The results on kinematic viscosity may be summarized as follows:

1. For each of the alcohol and mineral oil groups of the liquids tested, a single curve represents the relation of the thermal coefficient of kinematic viscosity to the kinematic viscosity. This relation is independent of the composition of the individual liquids and solutions and of the temperature of the liquid, except for temperatures close to the freezing point. This relation is also true for a limited temperature interval for the group of pure animal and vegetable oils.

2. For the three groups of liquids tested, no one liquid or solution in a particular group had a thermal coefficient at a given kinematic viscosity which varied more than 10 per cent from the mean value for the group.

3. Relatively, at a temperature well above their freezing points, the pure animal and vegetable oils have the smallest thermal coefficient of kinematic viscosity. The coefficient of the mineral oil group is less than that of the alcohol group, but the difference is slight.

ALTITUDE LABORATORY TESTS OF AIRCRAFT ENGINES

Fourteen years ago the National Bureau of Standards designed and built the world's first laboratory for determing the performance of aircraft engines under the precise conditions of low temperature and rarefied air which exist at high altitudes. The so-called altitude chamber where the engine is mounted for test is a reinforced concrete box capable of withstanding an external pressure of a ton per square foot. Powerful vacuum pumps evacuate the chamber and take away the exhaust gases. A shaft carried through the wall of the chamber connects the engine with a dynamometer for controlling the load and measuring the power developed. Connections are also made through the chamber walls for supplying metered quantities of air, fuel, oil, and water to the engine; for adjusting throttle and spark advance; and for measuring the temperatures and pressures in and about the engine. Thus, all operating conditions are controlled and all measurements made without entering the altitude chamber during a test.

As reported at the Fifth National Technical Aeronautic Meeting of the American Society of Mechanical Engineers in Baltimore on May 12, altitude laboratory tests have been made for the Army or the Navy on many representative aircraft engines, both American and foreign. In addition to tests of particular engines under standard conditions, much general information has been obtained as to the influence of engine design and operating conditions on performance. The effects of temperature and pressure on engine power and the gain obtainable by supercharging are illustrated by results of tests made in the altitude laboratory on a modern 12-cylinder water-cooled aircraft engine.

There is needed at the present time a corresponding altitude laboratory for the accurate testing of large air-cooled aircraft engines under the conditions encountered in flight. Such a laboratory will differ from the present installation chiefly in having provision within the evacuated engine chamber for the circulation of low-density air at the high velocity required for efficient engine cooling. The Navy has already made tests of certain air-cooled engines under approximate altitude conditions by controlling the pressure of the air supplied to the carburetor and connecting a suction line to the engine exhaust manifold.

OIL FILTER FOR AUTOMOBILES

A sample of crank-case oil which had been used for 1,000 miles in the engine of a 6-cylinder passenger automobile equipped with a new design of fullers' earth oil filter was tested recently by the bureau with the following results:

Color No.	4½
Neutrality No.	0.07
Precipitation No.	Trace
Dilution, per cent	7
Viscosity at 100° F., seconds	174

A second sample, taken after 2,000 miles of service, had a neutrality No. of 0.10. It is to be expected that filtration of used crank-case oil through fullers' earth will remove all dirt from the oil and maintain a comparatively light color. The chief point of interest in the above test is that a practical filter of this type can be installed under the hood of an auto-

mobile which will maintain the oil in a high state of purity over a long period of service.

THERMAL PROPERTIES OF ALCOHOL AND BENZINE

A series of experiments at the bureau to determine two important thermal properties of certain familiar liquids has just been completed. Methyl or wood alcohol, ethyl or grain alcohol, and benzene have been the subjects of this investigation. It is now possible to say, with an error of less than one-tenth of 1 per cent, how much energy in the form of heat is required to raise the temperature of a known mass of any one of these liquids from one value to another. The quantity of heat energy required to evaporate known masses of these liquids has also been measured with approximately the same precision, and such values are now available as the most important result of the present work.

Values of these properties which have been measured by previous investigators are discordant, and some of them must necessarily be very inaccurate. This recent work reduces the magnitude of the uncertainties which previously existed. The results here obtained find numerous applications, not only in science, but also in industrial processes involving production and purification of the substances.

The work will be reported in full in the May number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

CONTROLLING DIMENSIONAL CHANGES IN ELECTROTYPES

Electrotyping is an accurate method of reproducing the designs of printing plates, and is extensively used for high-grade printing, including halftones. Slight changes in the dimensions of a plate used for 1-color printing are usually not objectionable. In 4-color printing, however, the four plates must register accurately in order to reproduce the originals. Difficulty is sometimes experienced by electrotypers in making plates for color printing that have exactly the same corresponding dimensions.

In an investigation at the bureau, made in cooperation with the International Association of Electrotypers, plates were made under practical shop conditions and were then measured carefully to determine what changes in dimension were produced in each step of the process. The conditions used in each operation were then varied, and these plates were measured in order to determine how closely each operation must be controlled to secure a high degree of uniformity; for example, to within a few thousandths of an inch.

The results showed that the operations that must be most closely regulated are the casting of the electrotype metal and the final curving of the plates. It is hoped that the application of these results and principles will contribute to the production of the highest grade of printing by means of electrotypes.

The work will be described at greater length in the May number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

STANDARDIZATION OF BINDERS BOARD

At a joint meeting of representatives of the Binders Board Manufacturers Association and the National Bureau of Standards held at the bureau April 2, 1931, technical data on binders board secured by the paper section of the bureau were discussed. These data were requested by the association to assist it in their proposed establishment of quality standards for binders board in cooperation with the bureau's commercial standards division.

The data were secured with the help of a research assistant from the association. Tests were made on 35 samples, comprising five different thicknesses of board from seven manufacturers. The boards were tested for thickness, weight, bursting strength, flexural strength, including deflection at time of rupture, and bending strength. Values for number of sheets per 50-pound bundle and specific gravity were calculated from the tests of weight and thickness. The boards were graded for strength in much the same order by the four different strength-testing methods used. The flexural strength test (performed by bending a strip until it broke, by means of stirrups affixed to a standard tensile breaking-strength tester) gave much the same type of information as the bending test, which was made with a Naumann-Schopper bending tester.

It was agreed that the data submitted were sufficient for the formation of quality standards, and this is to be undertaken immediately by the association.

DE-INKING TESTS OF STAMPED ENVELOPES

De-inking tests of waste stamped envelopes have been successfully completed in the bureau's paper mill. The tests were made at the request of the Post Office Department to assist in profitable disposal of the defective envelopes produced in the course of manufacture of over 3,000,000,000 envelopes annually. While the number of defective envelopes is relatively small, the aggregate tonnage is worthy of consideration for reuse in making paper.

The appearance and tests of paper made from the de-inked waste on a semicommercial scale show that a very satisfactory pulp can be prepared from the mutilated stamped-envelope waste by the ordinary de-inking process. Paper consisting entirely of redeemed envelope waste nearly met the Government specification for stamped envelope paper, and paper consisting of 40 per cent stamped-envelope waste and 60 per cent sulphite pulp was above the specification.

CORROSION-RESISTANT PIPE MATERIALS

The results of the bureau's investigation of soil corrosion indicate that although the majority of soils are noncorrosive or only slightly corrosive, there are a number of soils in various parts of the country that are severely corrosive with respect to the commonly used pipe materials.

Four methods of preventing corrosion in these soils have been considered: (1) The surrounding of the pipes by noncorrosive soils transported from other regions; (2) electrical or cathodic protection; (3) metallic and bituminous protective coatings; and (4) the use of corrosion-resisting metals.

The development of the fourth method of avoiding soil corrosion has been urged by many owners of pipe lines, and pipe makers are offering a considerable number of comparatively new pipe materials, the effectiveness of which can only be determined by tests under various soil conditions.

In order to be of service to makers and users of pipe the bureau has decided to cooperate in an attempt to determine the performance of corrosion-resistant pipe materials in a number of kinds of corrosive soils. The purpose of the test is to secure scientific and practical data on the relations between pipe materials and soils as bases for the development by manufacturers of better and more corrosion-resisting pipe. An effort will be made to minimize the element of comparison of materials and to discourage the use of the data for sales promotion purposes.

Manufacturers desiring to submit materials for test should write to the National Bureau of Standards at once for information as to conditions under which the materials will be tested.

FREEZING AND THAWING TESTS OF SAND-LIME BRICK

Absorption determinations and freezing and thawing tests were made on sand-lime brick primarily to determine the value of absorption requirements in specifications as an index of weather resistance. Little relation between amount of absorption and resistance to freezing and thawing was apparent. It was found, however, that a brick having both a fast rate of absorption in partial immersion and a high strength was likely to withstand freezing and thawing satisfactorily.

ENGLISH CHINA CLAY

In order to investigate some of the characteristics of the colloids of a clay, the ignition loss, silica content, RO and R_2O_3 content of the colloidal fractions of 10 English china clays have been determined. The silica was determined by double dehydration and corrected for the amount carried down by the R_2O_3. The R_2O_3 was obtained by double precipitation. Calculation of the $SiO_2 : R_2O_3$ ratios from the chemical analyses of the colloids showed a variation of from 1.91 to 2.85. The same ratios, obtained from the analyses of the original clays, varied from 1.96 to 2.13. There was no apparent relation between the ratios obtained from the clays and those from the extracted colloids. For example, the clay having the lowest $SiO_2 : R_2O_3$ ratio yielded the colloid which had the highest ratio. In most cases the ratio was higher in the colloid than in the original clay. Two clays were exceptions to this rule.

The RO content of the colloidal fractions of the clays varied from 1.60 to 9.17 per cent, being in nearly all cases higher than for the original clays, which showed a variation of from 1.47 to 2.75 per cent. Here again there was no obvious relation between the clay and its colloidal extract. The same can be said of the ignition loss,

which in some cases was higher for the colloid fraction and in others lower than for the original clay.

Insufficient data have been collected to warrant any conclusions at this time. It is hoped that a determination of the dialysable bases in the clays, and the percentage of colloids, by water absorption of hydrogen-saturated samples of the clays and their colloids, will indicate more clearly the function of the colloids.

SPECIFIC GRAVITY AND POROSITY OF KAOLINS AFTER FIRING

In connection with a study of the differences found in linear thermal expansion of kaolins obtained from some of the more important world sources it seemed advisable to determine among other properties the true specific gravity and porosity. The values obtained after firing these materials to six different temperatures are tabulated below. The pyrometric cone equivalent (softening point) of each of the five kaolins included in this work was 35.

North Carolina kaolin shows the smallest change in porosity over the range of temperatures used and English china clay the greatest. In general, the specific gravity slightly increases with the increase of temperature to 1,250° C., decreases up to 1,400° C., and increases again at 1,500° C. The greatest changes in this property due to increasing temperature of firing are indicated by the Georgia and Zettlitz kaolins.

Kaolin identity	True specific gravity and porosity	Temperature of firing (° C.)					
		1,150	1,200	1,250	1,300	1,400	1,500
North Carolina	Specific gravity	2.709	2.711	2.732	2.696	2.706	2.707
	Porosity, per cent	46.45	45.78	43.50	41.18	34.60	31.80
Delaware	Specific gravity	2.712	2.724	2.719	2.705	2.675	2.689
	Porosity, per cent	39.47	37.18	32.10	24.02	6.79	1.50
Georgia	Specific gravity	2.748	2.787	2.801	2.815	2.781	2.793
	Porosity, per cent	39.0	33.32	32.3	30.18	9.10	2.57
Zettlitz	Specific gravity	2.748	2.755	2.762	2.733	2.695	2.749
	Porosity, per cent	37.17	34.42	30.7	22.12	1.74	.64
English	Specific gravity	2.714	2.723	2.725	2.734	2.702	2.700
	Porosity, per cent	41.15	37.00	28.40	22.72	10.04	.50

FUSION PROPERTIES OF TYPICAL COMMERCIAL GROUND-COAT ENAMELS

The present item concerns a continuation of an investigation referred to in TECHNICAL NEWS BULLETIN No. 164 (December, 1930) under the title Effect of Variations in Composition on Properties of Vitreous Enamels. A group of ground-coat enamels, varying in flint-feldspar ratio and in sodium-boric oxide ratio over the moderate extremes of practical limits, has been subjected to various fusion tests, as follows: (*a*) Miniature cone deformation tests, (*b*) "fusion block" flow tests, (*c*) slumping-temperature tests, and (*d*) "button" tests. The method of making cone deformation tests is well known. The fusion-block test consists in packing a cavity in the block with enamel powder and heating the whole on a definite schedule. The enamel flows down a steeply inclined plane, bearing calibration marks, and the time and temperature required for the stream to pass certain calibration marks are observed. The slumping temperature is taken as that temperature at which a specimen of enamel ceases to increase in height and begins to slump with increase in temperature, as indicated by interferometer measurements. The "button" test consists of subjecting cylinders of enamel powder to a standard heat treatment and observing the height and diameter of the resulting "buttons."

The following table applies only to the cone deformation temperatures of one set of enamels, but is also fairly typical of the effect of these variations in composition upon the refractoriness of the enamels as indicated by all of the other above-mentioned tests.

Enamel	Composition [1]				Cone deformation temperatures	
	Feldspar	Flint	Sodium oxide	Boric oxide		
	Parts	*Parts*	*Parts*	*Parts*	*° C.*	*° F.*
a	35	25	17	13	645	1,193
b	35	25	14	16	670	1,238
c	35	25	11	19	690	1,274
d	30	30	17	13	648	1,198
e	30	30	14	16	676	1,249
f	30	30	11	19	698	1,289
g	25	35	17	13	659	1,218
h	25	35	14	16	688	1,270
i	25	35	11	19	707	1,304

[1] Constant portion of batches not given.

From this table and other similar data which can not be given here it is apparent that variations in the sodium-boric oxide ratio had considerably more effect upon the refractoriness than was produced by variations in the flint-feldspar ratio. Thus, the change from (*a*) to (*b*), representing a replacement of three parts of sodium oxide by boric oxide, caused an elevation in cone deformation temperature of 25° C. (45° F.), while the change from (*a*) to (*g*), representing a replacement of 10 parts of feldspar by flint, caused an elevation of only 14° C. (25° F.). In the first case the numerical value of the ratio of the two constituents involved was reduced by about one-third, while in the second case it was reduced by approximately one-half.

NEW AND REVISED PUBLICATIONS ISSUED DURING APRIL, 1931

Journal of Research[1]

Bureau of Standards Journal of Research, Vol. 6, No. 4, April, 1931 (RP Nos. 292 to 302, inclusive). Price, 40 cents. Obtainable by subscription.

Research Papers[1]

(Reprints from Journal of Research)

RP273. The band spectra of scandium-, yttrium- and lanthanum monoxides, W. F. Meggers and J. A. Wheeler. Price, 15 cents.

RP277. Compressive tests of jointed C.365S.C.-section columns, J. H. Edwards, H. L. Whittemore, and A. H. Stang. Price, 15 cents.

Circulars[1]

C391. Standard thicknesses, weights and tolerances of sheet metal (customary practice). Price, 10 cents.

Commercial Standards[1]

CS27–30. Plate glass mirrors. Price, 5 cents.

Building and Housing[1]

BH15. Care and repair of the house; V. B. Phelan. Price, 20 cents.

Commercial Standards Monthly[1]

Commercial Standards Monthly, Vol. 7, No. 10; April, 1931. Price, 10 cents. Obtainable by subscription.

Technical News Bulletin[1]

Technical News Bulletin No. 168, April, 1931. Price, 5 cents. Obtainable by subscription.

LETTER CIRCULARS PREPARED DURING APRIL, 1931[2]

LC300. Aquarium cement.

LC301. Traffic paint. (Replaces LC–262.)

OUTSIDE PUBLICATIONS[3]

Fundamental properties of insulating liquids. H. L. Curtis; Bulletin of the Utilities Research Commission (Chicago, Ill.), Vol. 2, No. 4, p. 1; April, 1931.

The automotive ignition coil. H. T. Darnell; National Advisory Committee for Aeronautics (Washington, D. C.), Report No. 374; April, 1931.

Federal studies of radio waves are described. George K. Burgess; United States Daily (Washington, D. C.), Vol. VI, No. 54, p. 4; May 5, 1931.

Procedure used in liquefaction of helium explained. H. C. Dickinson; United States Daily (Washington, D. C.), Vol. VI, No. 34, p. 4; April 11, 1931.

An automatic constant level device for liquid air. R. B. Scott and F. G. Brickwedde; The Review of Scientific Instruments (Ithaca, N. Y.), Vol. 2, No. 3, p. 171; March, 1931.

Record protection and office equipment. S. H. Ingberg; Quarterly of the National Fire Protection Association (Boston, Mass.), Vol. 24, No. 4, p. 410; April, 1931.

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[1] Send orders for publications under this heading with remittance only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 40 cents. Subscription to Journal of Research, $2.75 per year; other countries, $3.50. Subscription to Commercial Standards Monthly, $1 per year; other countries, $1.25.

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[3] "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

Fuel research at the Bureau of Standards. O. C. Bridgeman; Oil and Gas Journal (Tulsa, Okla.), Vol. 29, No. 42, p. 143; March 5, 1931.

Strength of welded shelf-angle connections. J. H. Edwards, H. L. Whittemore, and A. H. Stang; Journal, American Welding Society (New York, N. Y.), Vol. 10, No. 3, p. 29; March, 1931.

Variations caused in the heating curves of glass by heat treatment. A. Q. Tool and C. G. Eichlin; Journal, American Chemical Society (Washington, D. C.), Vol. 14, No. 4, p. 276; April, 1931.

Elimination of odd sizes means lower costs to buyers. E. W. Ely; Southwestern Purchaser (Dallas, Tex.), Vol. X, No. 6, p. 10; March, 1931.

Ely speaks on simplification practice at Tulsa, Okla. National Association of Purchasing Agents Meeting. E. W. Ely; Mid-Continent Purchasor (Tulsa, Okla.), Vol. 14, p. 1; March 6, 1931.

Federal Government's efforts to aid municipalities. J. S. Taylor; United States Daily (Washington, D. C.), Vol. VI, No. 34, p. 10; April 11, 1931.

How big is a quantum? Paul R. Heyl; Scientific American (New York, N. Y.), Vol. 144, No. 5, p. 328; May, 1931.

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